



GB04/3255



INVESTOR IN PEOPLE

**PRIORITY DOCUMENT**  
SUBMITTED OR TRANSMITTED IN  
COMPLIANCE WITH  
RULE 17.1(a) OR (b)

The Patent Office  
Concept House  
Cardiff Road  
Newport  
South Wales  
NP10 8QQ

REC'D 17 SEP 2004

WIPO

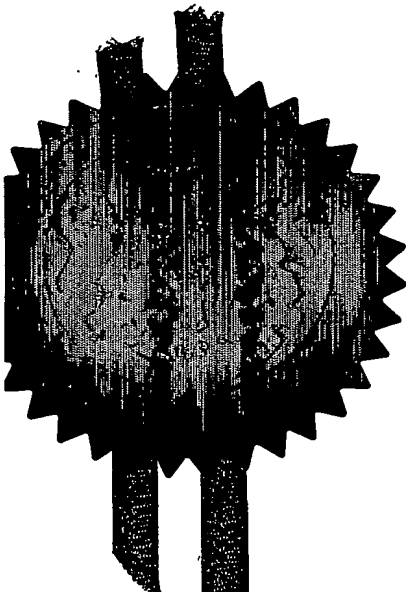
PCT

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.



Signed

*Andrew Gurney*

Dated

1 September 2004

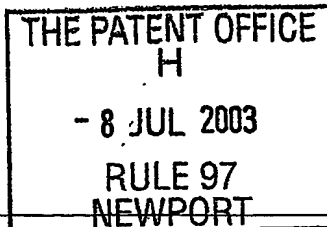
**BEST AVAILABLE COPY**



09JUL03 1621164-1 093334  
P01/7700 0:00-0316004.1

# Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)



The Patent Office  
Cardiff Road  
Newport  
South Wales  
NP10 8QQ

1. Your reference

CORE CONTROL

2. Patent application number

(The Patent Office will fill in this part)

0316004.1

- 8 JUL 2003

3. Full name, address and postcode of one or of each applicant (underline all surnames)

ZEROSHIFT Ltd  
The Coplan Building  
Michigan Drive  
Tongwell, Milton Keynes

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

MK15 8HQ 8669301001

4. Title of the invention

Control Method for Discrete Ratio Transmissions

5. Name of your agent (if you have one)

N/A

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

As above

Patents ADP number (if you know it)

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number  
(if you know it)

Date of filing  
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing  
(day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if

Yes

- a) any applicant named in part 3 is not an inventor, or
  - b) there is an inventor who is not named as an applicant, or
  - c) any named applicant is a corporate body.
- See note (d))

**Patents Form 1/77**

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form

Description

Claim(s)

Abstract

Drawing(s)

NIL

FOUR ✓

NIL

NIL

NIL

*JML*

10. If you are also filing any of the following, state how many against each item.

Priority documents

NIL

Translations of priority documents

NIL

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

NIL

Request for preliminary examination and search (Patents Form 9/77)

NIL

Request for substantive examination (Patents Form 10/77)

NIL

Any other documents (please specify)

NIL

11.

I/We request the grant of a patent on the basis of this application.

Signature

Date 7th July 83

12. Name and daytime telephone number of person to contact in the United Kingdom

Bill Martin

01908 617 469

**Warning**

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

**Notes**

- If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.
- Write your answers in capital letters using black ink or you may type them.
- If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.
- If you have answered 'Yes' Patents Form 7/77 will need to be filed.
- Once you have filled in the form you must remember to sign and date it.
- For details of the fee and ways to pay please contact the Patent Office.

Patents Form 1/77

**BEST AVAILABLE COPY**

## **Control Method for Discrete Ratio Transmissions**

This invention relates to a method for improving shift quality of transmission systems having discrete gear ratios and rapid gearshifts such as that described in application GB 0310482.5.

Where the transition between discrete gear ratios is virtually instantaneous there is little or no time for the inertia of the drive or driven device to dissipate before the next gear ratio is engaged. This causes inertia spikes.

In order to smooth out such shifts, a new approach to shift strategy must be devised.

It is one object of the present invention to provide a means for the control of rapid shifting transmission systems to reduce or eliminate inertia spikes when changing between discrete gear ratios.

This invention is for a method for controlling a transmission system having at least two gear ratios, and preferably, a means to provide slip of the power (such as a clutch) in order to provide shifts with minimum fluctuation in power through the drivetrain throughout the shift.

The method includes (but is not limited to) setting a slipping device to, or near to, the onset of slip prior to effecting a gear shift so that inertia or torque spikes during the shift process (due to the shift) between the power source, and the driven device, are unable to be fully transferred through the driveline.

Additionally or alternatively, drive (engine) power may be reduced on an up shift and increased on a downshift to reduce torque spikes during shifts. Both scenarios result in reduced period of clutch slip thus increasing clutch life.

Traction control may be used to control wheel-spin during shifts.

Various embodiments will now be described using the drivetrain of a motor vehicle as an example:

**BEST AVAILABLE COPY**

Any fluctuations in driveline torque to the driven wheels may reduce shift quality and provide the potential for breaking traction. Shift quality control is therefore best dictated by sensing torque changes in the driveline.

The control system is programmed to maintain constant driveline torque during gearshifts to pre set limits such as less than 2% change from that sensed immediately prior to the shift.

It is critical that the control system does not cause a driveline torque reversal at the instant the shift is made. This would inhibit the function of the two-way engagement system (with the exception of the kick-down sequence below).

An example for an up shift includes the following:

*A change is instigated by the driver or a management system.*

*The management system then:*

*Detects the call for a change and;*

*Takes a reading of drive torque on the clutch output side of the driveline with a torque sensor or a strain gauge, and;*

*Activates the servo / actuator controlling the clutch to commence reduction of the pressure between the clutch plates until the clutch plates begin to slip relative to each other. Slip is detected by comparing RPM sensors (Hall effect) on the input and output side of the clutch, and;*

*Holds the clutch at that pressure, and;*

*Activates the actuators on the selectors to shift ratios, and;*

*Overrides driver throttle position to reduce engine power (reduce fuel supply) to assist the maintenance of the previously measured driveline torque level and;*

**BEST AVAILABLE COPY**

*Continuously attempts to reduce clutch slip without exceeding the maximum allowable variation in driveline torque; and*

*Continues the above step until the clutch ceases to slip; and*

*Activates the clutch actuator to restore the clutch to the in gear pressure condition, and;*

*Attempts to restore engine torque to the level before the shift without exceeding the drive-shaft torque level, and*

*Continues the above step until engine power is restored, and*

*Restores the engine control to driver / throttle input.*

Where confirmation of a change in gear ratio is required, a Hall effect sensor or similar may be used to detect the position of an engagement means inside the gearbox.

The method for a decelerating down shift is identical to the above with the single exception that:

*Upon engagement of the new gear, fuel supply to the engine is increased instead of reduced as above.*

For a downshift under acceleration (kick-down) the method is as per the decelerating downshift above except that:

*Immediately prior to and during the shift the control system causes a momentary reduction of engine torque to, or near to zero (fuel cut) to allow the shift to occur. Throttle is then returned to that required to maintain drive-shaft torque (driver override) or driver input (whichever is the greater).*

*Due to windup in the driveline, the shift should be made immediately upon the drive shaft torque sensor detecting the torque reduction to, or near to zero. At*

*that instant the shift can be made and the torque reinstated. It should take no more than 20 milliseconds for the torque to reduce, then a further 20 milliseconds for the shift, then a further 20 milliseconds to reinstate the torque.*

*A throttle blip may be added during the shift to increase engine speed prior to engaging the lower ratio. This may mean a hesitation at the neutral point during the shift, thus an increase beyond the 20 millisecond shift time.*

For a kick down to be required the car is in the wrong gear and therefore unable to accelerate at the required rate until the shift is completed. This means that the momentary interruption in torque for the shift will be virtually undetectable.

Prior to the engagement of any gear the gear/ shaft relative rotational positions may be measured (Hall effect) to ensure that the engagement is within the open window of the locking system to reduce wear.

Unless the context indicates otherwise: one or more of any of the above steps may be performed simultaneously; and sequences and/or parts of sequences may combine.

---

Modifications and variations such as would be apparent to the skilled addressee are considered to fall within the scope of the present invention.